ConSat-1

**Payload: Determination of communication timing intervals between satellite and Ground Station and timing intervals of satellite passing over SAA region.**

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## Introduction.

STK software was used to determine time intervals for communication with Ground station. Though, time, when satellite’s payload is working in SAA region, was not determined because of the limitations in software version (freely accessible software lack of some modeling features).

## Software simulations results.

### **Used assumptions and applied parameters to the created model in STK.**

Nanosat has circular orbit and orbital parameters of ISS

<http://heavens-above.com/orbit.aspx?satid=25544>

|  |  |
| --- | --- |
| Epoch (UTC): | 19 December 2015 21:54:19 |
| Eccentricity: | 0.0008228 |
| inclination: | 51.6437° |
| perigee height: | 397 km |
| apogee height: | 408 km |
| right ascension of ascending node: | 237.1902° |
| argument of perigee: | 299.8403° |
| revolutions per day: | 15.54932623 |
| mean anomaly at epoch: | 233.9234° |
| orbit number at epoch: | 97693 |

Period: 92.69 min

Radius of Earth: 6378 km

SMa: 6779 km

It is found that the SAA region of 860 km altitude lies between the geographic longitude -100° ~ 40° and geographic latitude -60° ~ 10°.

Coordinates of the Ground station used in simulations are 45.457908 and -73.641529.

Nanosat: the dual-band spring-steel monopole antenna has omnidirectional radiation pattern in the azimuth plane (perpendicular to the cubsat z-axis).

Ground Station: two circular polarized Yagi antennas.

More details can be found in Appendix A.

### **STK software simulations results.**

Table 1 illustrates the timing intervals of communication between satellite and Ground Station.

Table 1. Communication time intervals between satellite and Ground Station.

|  |  |  |  |
| --- | --- | --- | --- |
| Access | Start Time (UTCG) | Stop Time (UTCG) | Duration (min) |
| 1 | 11:20.9 | 19:35.4 | 8.242 |
| 2 | 45:51.1 | 56:36.4 | 10.756 |
| 3 | 22:26.1 | 33:02.8 | 10.611 |
| 4 | 59:27.4 | 09:54.3 | 10.449 |
| 5 | 36:01.8 | 46:52.8 | 10.85 |
| 6 | 12:33.1 | 22:37.1 | 10.067 |
| 7 | 52:19.9 | 53:29.5 | 1.159 |

Timing intervals of satellite moving over SAA region is not precise and provided just to confirm incapability of this STK software version. Table 2 demonstrates only five accesses to the region that is underestimated value compared to the expected one.

Table 2. Time intervals of satellite passing over SAA region.

|  |  |  |  |
| --- | --- | --- | --- |
| Access | Start Time (UTCG) | Stop Time (UTCG) | Duration (min) |
| 1 | 04:45.6 | 06:03.5 | 1.299 |
| 2 | 37:41.4 | 47:44.8 | 10.057 |
| 3 | 14:06.5 | 23:43.1 | 9.61 |
| 4 | 33:42.3 | 44:11.9 | 10.493 |
| 5 | 10:46.3 | 19:59.0 | 9.211 |

Figure 1 (a, b) illustrates 2 D outputs from STK and demonstrates orbital paths of satellite and identified communication of nanosat and Ground Station and satellite in SAA region.

E:\ConSat-1\STK-april2015\CS1Payload\2d-dec20-2.tif

a)

E:\ConSat-1\STK-april2015\CS1Payload\2d-dec20-3.tif

b)

Figure 1. a) STK simulation output in 2D of satellite in region of Ground Station and b) 2D output of satellite moving over SAA area.

## Conclusion.

Conducted simulations demonstrate that satellite accesses Ground Station 7 times per day. Five accesses will have time interval of 10 minutes. As it can be seen, the access in SAA region did not covered all specified area and provide underestimated number of satellite passing over SAA area.

## Appendix A.

Yagi antennas, maximum power 100W output; 420-440 MHz (uplink) and 144-148 MHz (down link).

<http://sv1bsx.50webs.com/antenna-pol/polarization.html>

M2 antenna 2MCP22 (144-148 MHz)

M2 antenna 436CP42UG (420-440 MHz)

1 deg. of latitude is 111.2 km